

REMARKS

The Office Action has rejected Claims 1-9 under 35 U.S.C. § 112, second paragraph, as allegedly failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. In addition, Claims 1-3 and 8 were rejected under 35 U.S.C. §102(b) as anticipated by U.S. Patent No. 5,966,942 to Mitchell (hereinafter "Mitchell"). Claims 1, 3 and 7-9 were rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 5,720,172 to Ishizaki (hereinafter "Ishizaki"). Additionally, Claims 1-9 were rejected under 35 U.S.C. §103(a) as unpatentable over U.S. Patent No. 6,256,998 to Gao (hereinafter "Gao") in view of JP-04-225755 (hereinafter the '755 Patent).

Applicants have amended the claims, which when considered with the comments hereinbelow are deemed to place the present cases in condition for allowance. Favorable action is requested.

Applicant has amended Claims 1, and 5-7 to explicitly recite that the circulating flow of gas is through the buffer volume. Support is found in the instant application on page 2, next to last and last line. No new matter is added to the application. As amended, there can be no question what is meant by "circulating flow". Thus, the rejection under 35 U.S.C. §112, second paragraph, is obviated. Withdrawal thereof is respectfully requested.

According to the Office Action, Mitchell teaches all the features of Claim 1 and discloses a pulse tube cooling system with a flow circuit, including a means to trap and then cool the fluid prior to the fluid being returned to the pulse tube. The Office Action avers that Ishizaki shows a pulse tube system with a flow circuit between the pulse tube and buffer volume with cooling means and bypass means.

Applicant respectfully traverses these rejections.

The object of the present invention is an improved means of removing heat from the hot end of a pulse tube refrigerator when it is remote from the warm end of the regenerator. The rectification circuit with cooling means of the present invention differs from both the Mitchell and Ishizaki references.

Mitchell describes the use of fluidic diodes to replace the conventional orifices that are typically used to control the flow into and out of the buffer volume. The fluidic diodes may be vortex tubes that can be helpful in rejecting heat. Gas flows in and out of the buffer volume and, like Ishizaki, most but not all of the gas circulates through separate tubes between the warm end of the pulse tube and the buffer volume. Mitchell does not teach or suggest the circulation of gas through the buffer volume using check valves.

Unlike the present invention, we note that the cooling means 13 of Ishizaki is a second radiator (see 13 in Figs. 3a, 3b, 12a and 12b). Fig. 12a of Ishizaki shows a heat exchanger in a line between the warm end of a single stage pulse tube and a buffer volume, and a check valve in a second line between the warm end of the pulse tube and a buffer volume. In Ishizaki gas "circulates" as it flows in and out of the buffer volume. At col. 17, line 46 Ishizaki states that most of the fluid circulates. Thus, the object of Ishizaki is improvement of the efficacy of regenerative machines by avoiding mixing warm and cool gases in passages as they flow back and forth. Ishizaki does not address the problem solved by the present invention of rejecting heat from a two stage pulse tube in a cryopump where the hot ends of the pulse tubes are remote from the valve mechanism.

However, to facilitate prosecution of the instant application, Claim 1 has been amended to include the limitations of claim 8 and indicate "passive" rectification and to indicate "two or

“more” pulse tubes. Support for this amendment is found at former claim 8, page 6, lines 3 and 4 and Fig. 2, 3, and 4 disclosing the application of the invention to two pulse tube refrigerators, and throughout the specification where rectification is via check valves.

With regard to the obviousness rejection, the Office Action avers that Gao discloses a pulse tube cooling system with a flow circuit connecting the pulse tube to a buffer volume with apertures for phase control but does not disclose cooling the gas entering the buffer volume. The Examiner then relies on the ‘755 Patent to teach that this feature is allegedly old in the pulse tube art and so it would have been obvious to modify Gao by adding cooling means to the gas entering the buffer volume to improve the cooling effect of the pulse tube.

The combination of Gao and the ‘755 Patent does not make the present invention obvious. From the abstract it appears that the ‘755 Patent does not support the Examiner’s reliance to show cooling the gas entering the buffer volume. The ‘755 Patent pertains to a heat exchanger for **radiation** adjacent to a pulse tube. In addition, the combination does not lead to the present invention. Further, there is no motivation to combine Gao with the ‘755 Patent.

For the foregoing reasons, Applicant submits that the present invention overcomes all the rejections in the Final Office Action and the claimed subject matter is patentable. A Notice of Allowance is respectfully requested.

In the event of any outstanding matters which might be settled by telephone, the Examiner is requested to contact the undersigned Applicants’ authorized representative.

Any fee due with this paper, not fully covered by an enclosed check, may be charged on
Deposit Account 50-1290.

Respectfully submitted,

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